Shinobu AKIYAMA*: **Chromosome numbers of the species in *Hydrangea chinensis*-complex in the Ryukyu Islands**

秋山　忍*: 琉球列島産アジサイ属カラコンテリギ群の染色体数

The total range of Hydrangeas resembling *Hydrangea scandens* (L. f.) Ser. and *H. chinensis* Maxim. covers the region from SW China to S Japan through S China, the Philippines, Taiwan and the Ryukyu Islands. These species are characterized by the compound cymose inflorescences without a distinct common peduncle and by the subinferior ovaries with two or three (or four) longer styles, and classified with *H. hirta* (Thunb. ex Murray) Sieb. from the mainland of Japan in the subsection Petalanthe (Maxim.) Rehder of the section Hydrangea (McClintock 1957). The specific delimitation of the complex is quite controversial. The Ryukyu Islands is located at the center of the range where this complex is conspicuously diversified morphologically. In the Ryukyu Islands from Yakushima southwestwards to Iriomote through Tokara and Amami Groups, four taxa, *H. grosseserrata* Engl., *H. Kawagoeana* Koidz., *H. liukiuensis* Nakai and *H. yayeyamensis* Koidz., were described and *H. chinensis* Maxim. has been recorded to occur in the Ryukyu Islands. In the latest monograph of the genus *Hydrangea*, McClintock (1957) united these taxa except *H. hirta* into a single species and named it as *H. scandens* with four subspecies, *scandens*, *liukiuensis*, *chinensis*, and *kwangtungensis*. *H. luteovenosa* from the mainland of Japan was treated as a synonym of subsp. *liukiuensis*. *H. grosseserrata*, *H. Kawagoeana* and *H. yayeyamensis* were reduced to synonyms of subsp. *chinensis*. Hatusima (1971) accepted her concept with some modifications. That is, *H. luteovenosa* was separated from subsp. *liukiuensis*, and both *H. grosseserrata* and *H. Kawagoeana* were regarded as a variety, var. *grosseserrata*, of subsp. *chinensis*. Kitamura (1979) proposed a modified concept. He regarded four distinct species in McClintock's *H. scandens*, and reported three taxa, *H. liukiuensis* and *H. chinensis* var. *chinensis* (including *H. Kawagoeana* and *H. yayeyamensis*) and var. *grosseserrata*, from the islands. Recently, Ohba (1989)

---

* Botanical Gardens, Faculty of Science, University of Tokyo, Hakusan 3-7-1, Bunkyo-ku, Tokyo 112.
東京大学 理学部附属植物園.

regarded these four, *H. grosseserrata*, *H. Kawagoeana*, *H. liukiuensis*, and *H. yayeyamensis*, as distinct species, and pointed out the necessity of further studies in order to reveal their relationships and taxonomy. In this paper I have tentatively adopted this concept, and named *H. chinensis* and the related species as *H. chinensis*-complex.

A number of chromosome counts for *Hydrangea* have been reported (Morinaga et al. 1929, Sax 1931, Schoennagel 1931, Matsuura & Sutô 1935, Sugiura 1936, Hamel 1953, Chuang et al. 1963, Nevling 1966, Sharma & Sarkar 1967-68, Hsu 1968, Mehra & Khosla 1969, Singhal et al. 1980, Pilatowski 1982, Funamoto & Tanaka 1988). These studies indicated that the species of the genus has $2n=36$ (except *H. involucrata*, $2n=30$) and the absence of polyploidy, excepting *H. paniculata* in which $2n=36, 72, 108$ were reported. Till now no cytological data of this complex is reported, though Chuang et al. (1963) and Hsu (1968) reported $2n=36$ chromosomes from *H. chinensis* of Taiwan. The present paper aims to elucidate cytological diversity among the populations in the species of the complex, which reveals the presence of polyploidy and adds new counts for four species to previous works.

Material and method The populations of *Hydrangea* (Tab. 1) were investigated in Yakushima Island, Tokunoshima Island, Okinawa Island, Ishigaki Island and Iriomote Island. The cuttings belonging to different individuals were obtained and cultivated in the green house, the Botanical Gardens, the University of Tokyo. Materials from Taiwan were also investigated (Tab. 1). The root-tips used for cytological observation were fixed. The pretreatment was made with 0.002 M 8-hydroxiquinolin solution for 2-3 hr at 18-20 C. After pretreatment, the root-tips were fixed with the solution of 3:1 alcohol-acetic acid. They were then stained with the 10:1 mixture of 2% aceto-orcein and 1N HCl for 16-24 hr and then squashed.

Results and discussion Though the species in the genus *Hydrangea* have diversified gross morphology enough to be classified to different series or sections, the previous cytological studies indicate that the chromosome number $2n=36$ ($n=18$) is widely prevailing in it (Morinaga et al. 1929, Sax 1931, Schoennagel 1931, Matsuura & Sutô 1935, Hamel 1953, Chuang et al. 1963, Nevling 1966, Sharma & Sarkar 1967-68, Hsu 1968, Mehra & Khosla 1969, Singhal et al. 1980, Pilatowski 1982, Funamoto & Tanaka 1988).

However, the diversity of chromosome numbers among populations and

Tab. 1. Chromosome numbers of *Hydrangea chinensis*-complex and the voucher data.

Taxon	Chromosome numbers (2n)	Voucher data
H. chinensis	36	Taiwan, Taichung, Kukuan. (May 16, 1985)
	36	Taiwan, Taichung, Kukuan. (Mar. 15, 1989)
	36	Taiwan, Ulai. (Mar. 22, 1989)
H. grosseserrata	36	Isl. Yakushima. (Apr. 15, 1984)
H. Kawagoeana	36	Isl. Tokunoshima, Mt. Inokawa. (May, 20, 1986)
	36	Isl Tokunoshima, Mt. Inokawa. (Mar. 3, 1989, no. 4 & 14)
	36	Isl. Tokunoshima, Mikyo. (Mar. 3, 1989, no. 38)
H. liukiuensis	36	Isl. Okinawa, Tanagagumui. (Jan. 31, 1988, no. 1 & 3)
	36	Isl. Okinawa, Mt. Nago. (Feb. 1, 1988, no. 14, 17, 30, 33 & 34)
	36	Isl. Okinawa, Mt. Tano. (Feb. 1, 1988, no. 49, 53 & 56)
	72	Isl. Okinawa, Mt. Yae. (Feb. 1, 1988, no. 35, 36, 37, 38, 39, 41, 42 & 43)
H. yayeyamensis	ca 144	Isl. Iriomote, Urauchi. (Mar. 17, 1987)
	ca 144	Isl. Iriomote, Maera. (Feb. 21, 1988)
	ca 180	Isl. Ishigaki, Mt. Omoto. (June 1988)
	ca 180	Isl. Ishigaki, Mt. Omoto. (June 23, 1988)

species in *H. chinensis*-complex is noteworthy. Though *H. grosseserrata*, *H. Kawagoeana* and *H. chinensis* (s. s.) have 36 somatic chromosomes in root-tips in all individuals counted, *H. liukiuensis* and *H. yayeyamensis* have higher numbers of chromosomes. Tab. 1 is a list of the somatic chromosome numbers counted in this study. Each chromosome is small, less than 3 μm in metaphase. Chromosome numbers of *H. grosseserrata*, *H. Kawagoeana*, *H. liukiuensis* and *H. yayeyamensis* were counted for the first time.

In the complex, *H. Kawagoeana* has widest range of distribution from Kuroshima Island (near Yakushima Island) to Iheya Island (near Okinawa Island) through Tokara Group of islands and Tokunoshima Island. I could count only the plants of three populations in Tokunoshima Island. All of these have 36 chromosomes in root-tips and are diploid (Fig. 1c). *H. grosseserrata*, endemic to Yakushima Island, resembling *H. Kawagoeana* in morphological features, is also confirmed to be diploid with 36 somatic chromosomes.

Among the four populations of *H. liukiuensis*, endemic to Okinawa Island, $2n=36$ (Fig. 1a) and $2n=72$ (Fig. 1b) were found. These are thought as diploid and tetraploid respectively. In three populations examined (Tanagagumui, Mt. Nago and Mt. Taño) all of the individuals counted had 36 chromosomes, and in a single population (Mt. Yae) all of those had 72 chromosomes. The ploidy level was found to be constant through populations. No geographical differentiation occurred within this species, because the tetraploid population was located at central part of the total range of distribution. The tetraploid population of *H. liukiuensis* might be thought to be derived from the diploid ones within Okinawa Island. The tetraploid individuals are hardly distinguishable from the diploid ones in morphological features.

H. yayeyamensis is known from Ishigaki Island and Iriomote Island only. All of the individuals counted from Iriomote Island had ca 144 chromosomes (Fig. 1f) and all of those from Ishigaki Island had ca 180 chromosomes (Fig. 1e). These are regarded as octaploid ($2n=144$, $x=18$) and decaploid ($2n=180$, $x=18$) respectively. It is noteworthy that such high ploidy is found in the genus *Hydrangea*. It is also remarkable that the ploidy level is differentiated between the islands, though the octaploid individuals from Iriomote Island are hardly distinguishable from the decaploid ones from Ishigaki Island. Moreover, it is interesting that the octaploid and decaploid *H. yayeyamensis* are very similar to the diploid *H. chinensis* (s. s.) from Taiwan.

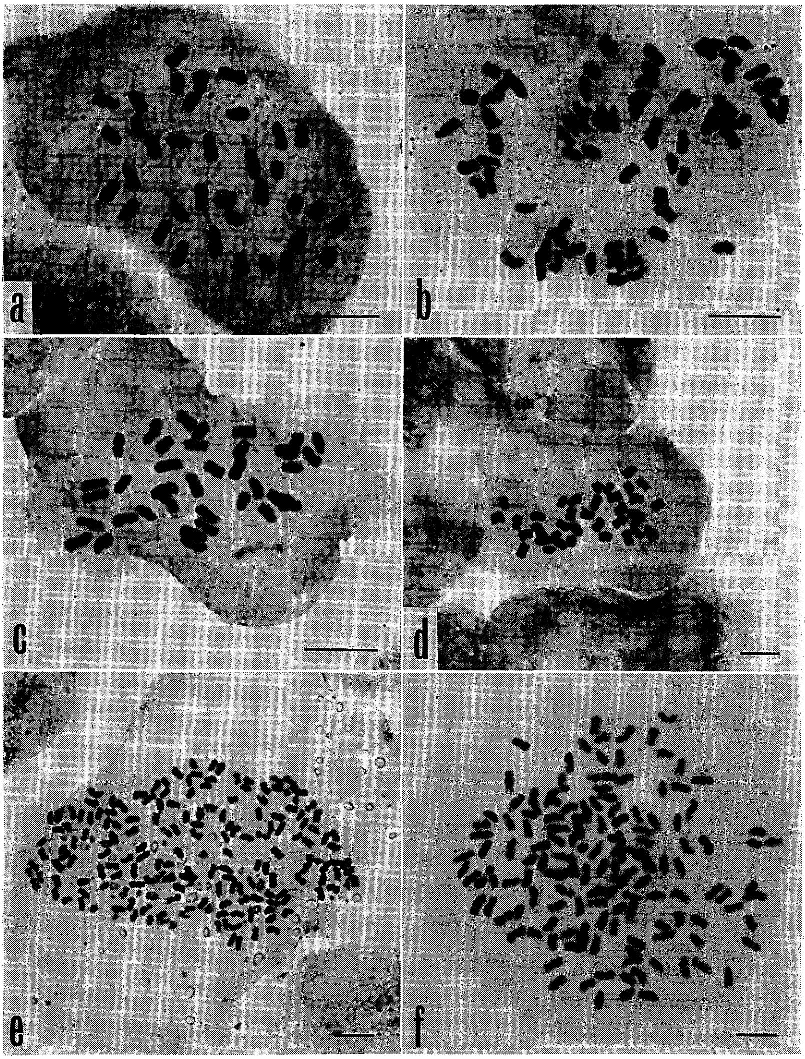

Fig. 1. Somatic chromosomes in metaphase. a: *Hydrangea liukiuensis*, 2n=36 (Isl. Okinawa, Tanagagumui). b: *H. liukiuensis*, 2n=72 (Isl. Okinawa, Mt. Yae). c: *H. Kawagoeana*, 2n=36 (Isl. Tokunoshima, Mt. Inokawa). d: *H. chinensis*, 2n=36 (Taiwan, Kukuan). e: *H. yayeyamensis*, 2n=ca 180 (Isl. Ishigaki, Mt. Omoto). f: *H. yayeyamensis*, 2n=ca 144 (Isl. Iriomote, Urauchi). Bar indicates 5 μm.

Chuang et al. (1963) and Hsu (1968) already reported $2n=36$ in *H. chinensis* from materials collected in Taiwan. I have obtained the same results from three individuals collected in different localities in Taiwan (Tab. 1, Fig. 1d). The three individuals resemble each other in morphological features, though *H. chinensis*-complex shows wider ranges of variation in Taiwan, particularly in the shape and the size of leaf, and consists of several names such as *H. angustifolia* Hayata, *H. angustipetala* Hayata and *H. formosa* Koidz. The Taiwanese plants which were observed to have 36 chromosomes in this study can be referred to *H. chinensis* itself, and are quite similar to the octaploid and decaploid *H. yayeyamensis* from Iriomote Island and Ishigaki Island. Further cytological studies are much needed to resolve the presence of higher ploidy levels in this complex, especially the derivation of *H. yayeyamensis* in Iriomote Island and Ishigaki Island.

I am grateful to Dr. M. Wakabayashi, Makino Herbarium, Tokyo Metropolitan University, for his technical advice. Thanks are also due to Dr. H. Ohba, University Museum, University of Tokyo for his criticism and guidance in the field survey. I wish to express my thanks to Mr. K. Nacejima, Okinawa, who accompanied with me to collect living materials of *H. liukiuensis*, and also to Dr. J. Murata and Mr. M. Hasebe, the Botanical Gardens, the University of Tokyo, who provided me some living materials especially from Taiwan.

References

Chuang, T.I., Chao, C.Y., Hu, W.W.L. & S.C. Kwan 1963. Chromosome numbers of the vascular plants of Taiwan. I. Taiwania no. 1, 51-66. Funamoto, T. & R. Tanaka 1988. Karyomorphological studies in some taxa of *Hydrangea* from Japan. La Kromosomo, II, **49**: 1583-1594. Hamel, J.L. 1953. Contribution à l'étude cytotaxonomique des Saxifragacées. Rev. Cytol. et Biol. Veg. **14**: 113-314. Hatusima, S. 1971. *Hydrangea*. Flora of the Ryukyus, 304-305. Okinawa-seibutsukyoiku-kenkyukai, Naha. Hsu, C.C. 1968. Preliminary chromosome studies on the vascular plants of Taiwan (II). Taiwania no. 14, 11-27. Kitamura, S. 1979. *Hydrangea*. *In* Kitamura, S. & G. Murata, Col. Ill. Woody Pl. **2**: 111-121 (in Japanese). Matsuura, H. & T. Sutô 1935. Contributions to the idiogram study in phanerogamous plants I. Journ. Fac. Sci. Hokkaido Imp. Univ. **5**: 33-75. McClintock, E. 1957. A monograph of the genus *Hydrangea*.

Proc. Calif. Acad. Sci. **29**: 147-256. Mehra, P.N. & P.K. Khosla 1969. *In* IOPB chromosome number reports XX. Taxon **18**: 213-221. Morinaga, E., T. Kano, Y. Maruyama & Y. Yamazaki 1929. Chromosome numbers of cultivated plants II. Bot. Mag. Tokyo **43**: 589-594. Nevling, L.I. 1966. *In* IOPB chromosome number reports VI. Taxon **15**: 117-128. Ohba, H. 1989. *Hydrangea*. *In* Satake, Y. et al. (eds.), Wild Fl. Jap. Woody Pl. **1**: 166-172. Heibonsha Co. Tokyo (in Japanese). Pilatowski, R.E. 1982. A taxonomic study of the *Hydrangea arborescens* complex. Castanea **47**: 84-98. Sax, K. 1931. Chromosome numbers in the liguneous Saxifragaceae. Journ. Arnold Arb. **12**: 198-206. Schoennagel, E. 1931. Chromosomenzahl und Phylogenie der Saxifragaceen. Engl., Bot. Jahrb. **64**: 266-308. Sharma, A. & A.K. Sarkar (eds.) 1967-68. Chromosome number reports of plants. Annual Report, Cytogenetics Laboratory, Department of Botany, University of Calcutta. The Research Bull. **2**: 38-48. Singhal, V.K., B.S. Gill & S.S. Bir 1980. *In* Chromosome number reports LXVII. Taxon **29**: 347-367. Sugiura, T. 1936. A list of chromosome numbers in angiospermous plants II. Proc. Imp. Acad. (Jap.) **12**: 144-146.

* * * *

アジサイ属カラコンテリギ群 (*Hydrangea chinensis*-complex) に含まれる植物が，日本では琉球列島の屋久島，黒島から石垣島，西表島までに分布する。この群の類縁関係を推察するためのデータが不足していることもあって，この地域に分布するヤクシマアジサイ (*H. grosseserrata*), トカラアジサイ (*H. Kawagoeana*), リュウキュウコンテリギ (*H. liukiuensis*), ヤエヤマコンテリギ (*H. yayeyamensis*) らの分類群の取り扱いは McClintock (1957), 初島 (1971), 北村 (1979), 大場 (1989) でそれぞれに異なっている。このため，琉球列島の各島から得た集団と台湾から得た個体について染色体数の検討を行った。ヤクシマアジサイ，トカラアジサイ，リュウキュウコンテリギ，ヤエヤマコンテリギの4種の染色体数は今回が初めての報告である。体細胞染色体数は、ヤクシマアジサイ，トカラアジサイが 2n=36 であった。リュウキュウコンテリギは調べた4集団のうち3集団で 2n=36（2倍体), 1集団で 2n=72（4倍体と考えられる）であり，それぞれ集団としては一定していた。ヤエヤマコンテリギは西表島では 2n=ca 144, 石垣島では 2n=ca 180 であり，それぞれの島では倍数体レベルは一定であった。台湾のカラコンテリギは 2n=36 であり，これまでの報告と一致した。

これまでの報告によると，アジサイ属では，タマアジサイ (2n=30) を除き，2n=36 の染色体数を持つ2倍体種がほとんどで，ノリウツギにのみ4倍体と6倍体が知られているだけであった。ヤエヤマコンテリギで今回報告された 2n=ca 144 と 2n=ca 180

は，それぞれ18を基本数とする8倍体と10倍体と考えられ，アジサイ属にこのような高次倍数体が生じていることは今回初めて明らかになった。カラコンテリギ群は，判明している限り，アジサイ属中で染色体数の倍数化が起きている唯一の種群といえる。また，同種とされる種内に見いだされた倍数体間の形態差はほとんどないことから，倍数化と形態的分化は相関しないと考えられる。

□ Nagendran, C.R. & M.S. Dinesh: **The embryology of Angiosperms. A classified bibliography (1965-1985)** 240 pp. 1989. Indira Publishing House, Michigan, U.S.A. ¥ ca 19,000. インドの学者によって作られた embryology の文献集である。Davis が1965年に文献集を出してから20数年経ち，その間に多くの論文が発表されたが，まとまった紹介が無く，文献の検索に不便であった。ソ連から Yakovlev et al. (ed.), Comparative embryology of flowering plants 1 (1981), 2 (1984) が出版され，一部の科については文献集ができているが，ソ連の本は入手しそこねると後で手に入れるのは困難なので，本書は便利である。ただ文献の収集が充分でなく，抜けているものがかなりあるように思われる。　（山崎　敬）

□ Troll, W. & F. Weberling: **Infloreszenzuntersuchungen an monotelen Familien** 490 pp. 1989. Gustav Fischer, Stuttgart. ¥ ca 19,000. Troll の Die Infloreszenzen, Typologie und Stellung, 1964-69 が出版されてから20年たつ。この本は有名ではあってもなかなか難解で，わざわざ英語の抄訳が出されている (Austral. Syst. Bot. Soc. Newsletter no. 30: 1-21, 1982)。Troll は花序に monotelic と polytelic の異なる構造があると主張した。これは系統的にもかなり重要な性質と考えられる。Troll の後継者で Troll の説をさらに発展させている Weberling は，本書で monotelic な花序を持つ19科について，詳細な花序の解説を行っている。科の名だけをあげておく。Caryophyllaceae, Nyctangiaceae, Aizoaceae, Mesembryanthemaceae, Portulacaceae, Ranunculaceae, Berberidaceae, Papaveraceae, Droseraceae, Crassulaceae, Saxifragaceae, Linaceae, Vitaceae, Leeaceae, Hypericaceae, Melastomataceae, Gentianacaea, Menyanthaceae, Loganiaceae, Apocynaceae.　（山崎　敬）

□ Grey-Wilson, C. (ed.): **A manual of alpine and rock garden plants** 278 pp. 1989. Timber Press, Portland, USA. ¥5,000. 最近「花の万博」に関連した問い合わせが多くなったので，参考のために入手した．ロックガーデン植物を属の ABC 順に配列し，同属内は近似植物でまとめてある．主として栽培上の留意点が簡単な記述と記号で記されている．　（金井弘夫）